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FARMERS' BULLETIN 1025

UNITED STATES DEPARTMENT OF AGRICULTURE

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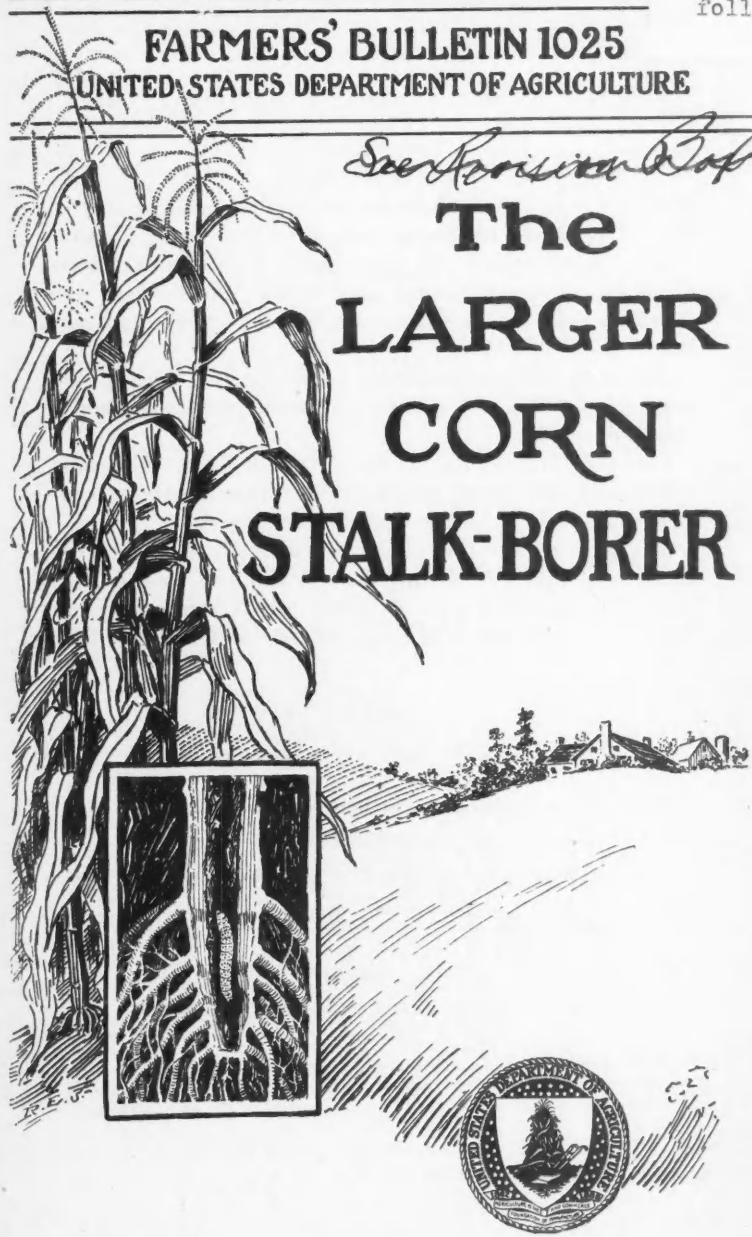
The LARGER CORN STALK-BORER



MANY a fine field of corn in the South Atlantic States is broken off by heavy winds during the later growing season. Examination will show that the stalks had been weakened by insects boring into them. The damage was done by a pale, dark-spotted caterpillar, the larger corn stalk-borer.

Only corn is injured seriously by this insect; some of the larger grasses are food plants, and sugar cane sometimes is damaged slightly.

This bulletin gives the life history of the insect, its feeding habits, and methods of combating it. There are two generations in a season, so greater vigilance is necessary.

The second generation passes the winter only in the corn roots, so if these are destroyed or plowed under deeply, the pest will be largely decreased. The injury is worst where corn follows corn, so rotation of crops will help to destroy the pest.

Contribution from the Bureau of Entomology,

L. O. HOWARD, Chief.

Washington, D. C. February, 1919.

THE LARGER CORN STALK-BORER.[1]

GEORGE G. AINSLIE,
Entomological Assistant, Cereal and Forage Insect Investigations.

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BROKEN STALKS AND BORER WORK.

IN MANY southern cornfields a heavy wind late in the season, before the corn is matured, does great damage by breaking the plants off at the surface of the ground. Usually these broken stems have been weakened by the burrows of a larva or caterpillar (fig. 1) known as the larger corn stalk-borer. Its work is largely within the

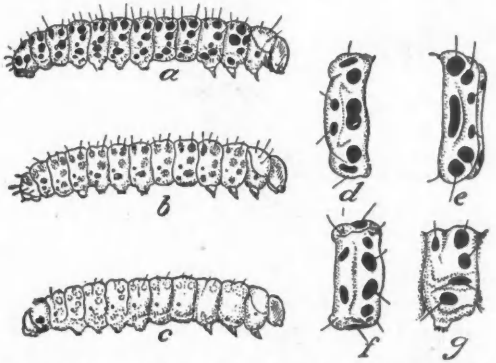

FIG. 1.—The larger corn stalk-borer: *a*, Summer form of larva; *b*, *c*, hibernating forms of larvæ; *d*, third thoracic segment from above; *e*, eighth abdominal segment from above; *f*, abdominal segment from above; *g*, same from side. *a*, *b*, *c*, Enlarged; *d*, *e*, *f*, still more enlarged. (Redrawn from Howard.)

stem of the plant and is so concealed that, in most cases, unless weather conditions make it conspicuous, the presence of the insect passes unnoticed.

[1] *Diatraea zeacolella* Dyar.

NOTE.—This publication supersedes Farmers' Bulletin 634.

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WHERE THE BORER IS FOUND.

This insect is very similar to the borer[1] of sugar cane occurring in the southern parts of Louisiana, Florida, and Texas, and in the Tropics, and for a long time was supposed to be the same. As it has proved to be distinct, it is probable that it is a native of the Atlantic States from northern Florida to Maryland, where it is now found. Even in the southern part of this region, where cane is grown, the insect rarely attacks it, although the closely related sugar-cane borer feeds on corn and sugar cane indiscriminately.

This corn borer is known to occur throughout the Atlantic States east of the Appalachians from Florida to Maryland and as far west as Alabama (fig. 2). What appears from its method of work to be the same insect has been reported from Arizona and New Mexico and north to Kansas. The exact western limits of its occurrence are unknown.

FIG. 2.—Map showing present known distribution of the larger corn stalk-borer.

EXTENT OF ITS DAMAGE.

It has been reported most frequently as injurious to corn in Georgia, South Carolina, North Carolina, and Virginia, but in 1898 many cornfields in the southern and eastern part of Maryland practically were abandoned because of its attacks. In 1909, at Waynesboro, Ga., cornfields were "at least one-third destroyed" by it and in October of the same year one-half of the cornstalks at Diamond Springs, Va., were infested, often with several larvæ each. At Clemson College, S. C., in 1909 and 1910, a majority of the plants in most fields were infested and several cases were observed where hundreds of stalks were broken and ruined by windstorms when the corn was about mature. In most cases it is the earlier planted corn that suffers most severely from the work of the larvæ in the bud.

NATURE OF THE DAMAGE.

These caterpillars damage corn in two ways. First, in the early part of the season, while the plants are small, they work in the "throat" of the young corn and, if the tender growing tip within the

[1] *Diatræa saccharalis crambidoides* Fabricius.

protecting leaves is once damaged, all chance that the plant will become a normal productive specimen is gone. In many sections this is commonly known as "budworm" injury, and while several other insects cause a similar mutilation of the leaf, a considerable proportion of the so-called "budworm" damage in many localities should be laid to this insect. Its work on the small plant appears later on the unfolded leaves as rows of small round or oval holes in straight lines across the leaves (fig. 3), very similar to those caused by the corn billbugs.

FIG. 3.—Work of the larger corn stalk-borer showing damage to the leaves caused by the larvæ of the first generation.

The more conspicuous and usually much the more serious form of injury chargeable to this pest, however, occurs later in the season. The larvæ, having left the leaves and descended to the lower part of the stalk, tunnel in the pith (figs. 4, 5). If they are at all numerous, their burrows so weaken the stalk that any unusual strain will lay it low and destroy all chance of its maturing. While many larvæ may live and work in one plant, it must be remembered that any infesta-

tion, however light, will weaken in some degree the vitality of the plant and cause a corresponding loss in the quality and quantity of the harvest.

DESCRIPTIONS OF THE DIFFERENT FORMS OR STAGES OF THE INSECT.

The four successive stages in the development of this insect are (1) the egg, (2) the larva, caterpillar, or borer, (3) the pupa, chrysalis, or resting stage, and (4) the adult or moth.

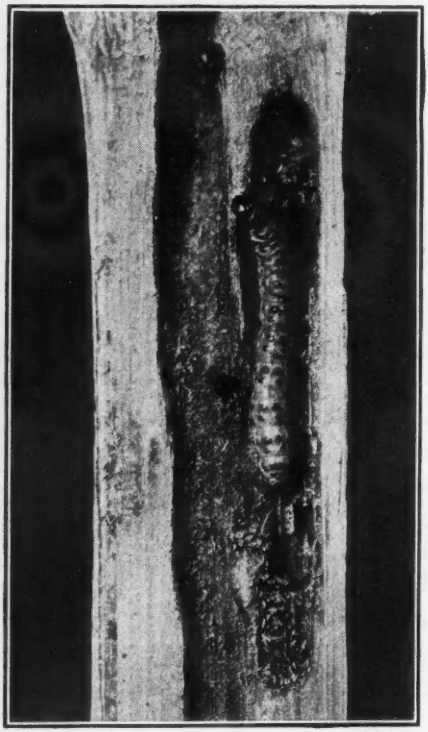

FIG. 4.—Work of the larva of the larger corn stalk-borer in cornstalk. Enlarged.

THE EGG.

The eggs (fig. 6) are flat and scalelike, almost circular in outline, and are placed in rows or irregularly, overlapping one another shingle fashion. From 2 to 25 eggs are laid in one place on the underside of a lower leaf, or occasionally on the upper side or on the stem. Creamy white when first laid, they change gradually to reddish brown and, in from 7 to 10 days, a minute, bristly, reddish caterpillar cuts a hole in the shell and crawls out through a narrow slit at one end. The eggs are about three one-hundredths of an inch (7.6 mm.) long and two-thirds as wide. After hatching, the white papery eggshells are soon washed off the leaves.

THE LARVA.

The larva of the first generation (fig. 1, *a*) when full grown is a robust, dirty-white caterpillar 1 inch in length, thickly covered with round or irregular dark spots, each of which bears a short, dark bristle. When the larva is small these markings almost touch one another, giving the whole insect a dark color and a hairy appearance. The head and the neck shield of all the stages are brownish yellow. The overwintering larva of the second generation (fig. 1, *b*, *c*) gradually loses the darker markings of the body and after the last molt

remains unspotted and light yellow, except for the head and the neck shield, which retain the brownish yellow color of the earlier stages.

THE PUPA.

When first formed, the pupa (fig. 7) is light honey-yellow in color, soon changing to a rich mahogany brown. It is about seven-eighths of an inch in length and contorts itself violently when disturbed. It lies in the cavity, usually with the head up. On emerging, the moth leaves the brownish shell of the pupal case partially withdrawn from the hole.

FIG. 5.—Work of the larvæ of second generation of the larger corn stalk-borer in old stalks. About natural size.

THE ADULT OR MOTH.

The female moth (fig. 8) varies from almost white to smoky yellow. The fore wings, which spread to about 1¼ inches, are darker than the hind wings, and bear faint markings. When at rest the wings are held close to the body, forming an acute triangle. Egg-laying occurs, for the most part, either at night or in the dusk of evening, the moths flying rapidly from plant to plant. The male moth usually is somewhat darker than the female and always smaller. The moths of both sexes occasionally appear at lights, but during the day they remain hidden in the "throat" of the corn plant, beneath the leaves or in some other sheltered place.

HABITS OF THE LARVAE OR BORERS.

Immediately upon leaving the egg in the spring each young larva of the first generation, spinning a silken thread behind it, goes down into the "throat" of the plant as far as the water or dew usually

standing there will allow, and begins to feed on the leaves, going back and forth through the yet unfolded clusters, and soon riddles the more tender leaves with aimless burrows. If the burrow reaches the tender terminal bud where the future joints are being formed, further growth at that point ceases, and the plant becomes stunted and misshapen, with no tassel. As the plant continues to mature, the larva "grows out," as the farmers say. Probably it is not the larva itself that "grows out" but the evidence of its work. The caterpillar soon forsakes the more leafy portion of the plant and attacks the stalk at or near the ground. Here a hole is cut through the outer wall of the stalk and the larva burrows upward for a short distance, after which it seems to run aimlessly through the pith, often even leaving the stalk and reentering it at another point. Turning upward, the caterpillar, when fully grown, bores toward the outside and cuts a circular hole in the outer wall of the stalk. Then, after spinning a few loose threads across the opening to keep out undesirable visitors, it retreats a short distance, plugs the burrow below with digested pith, and in the chamber thus formed slowly changes to the next stage, the resting stage or pupa (fig. 7).

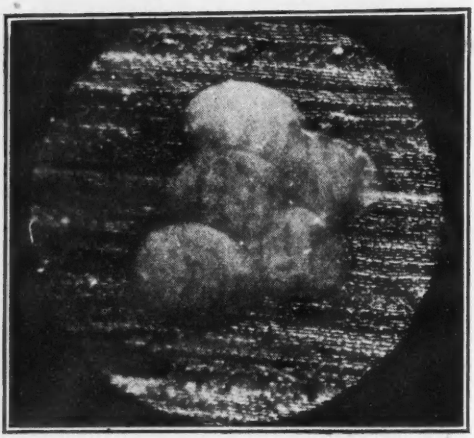

FIG. 6.—Eggs of the larger corn stalk-borer. Highly magnified.

Seldom is the stalk damaged above the third joint from the ground although the larvæ, when small, are found in the large midribs of the lower leaves and later in the season, when the food supply is restricted, even in succulent "nubbins" farther up. Sometimes they penetrate the underground part of the stalk in feeding and enter some of the larger brace-roots for a short distance.

The larvæ of the second generation work in a similar manner, except that at the time they appear the tassel has been formed; hence the damage is now confined altogether to the lower stalk. Thus, instead of arranging to pass the pupal period in the stalk above ground, they penetrate to the root and there, as larvæ, pass the winter in a dormant state (see title page).

LIFE OF THE INSECT THROUGHOUT THE YEAR.

During the winter this enemy of the corn plant is found as a robust creamy-white larva of the second generation in the lower part of the stalk, or, if the corn has been cut, in the stubble. Here the larva forms a small cavity below the surface of the ground, well protected from birds, predatory insects, and unfavorable weather conditions. From the time the corn is mature in the fall until about corn-planting time in the spring this caterpillar remains inactive. About the time the ground is being prepared for corn, from March 15 to April 30, depending on the locality, this larva changes into a reddish-brown pupa or chrysalis. After ten or more days in this stage the adult insect emerges from the pupal case as a pale yellowish-brown moth (fig. 8) with wings which spread about 1¼ inches. The moths mate and the females begin to deposit eggs on the underside of the leaves. The larvæ hatching from these eggs form the first generation of the season.

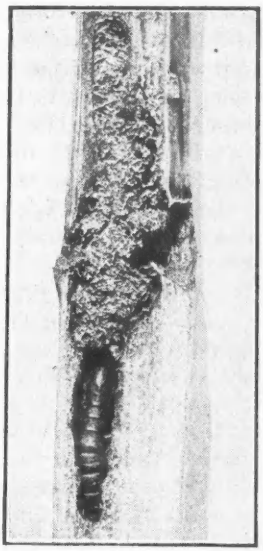

FIG. 7.—Pupa of first generation of the larger corn stalk-borer in injured stalk of corn. About natural size.

The eggs hatch in from 7 to 10 days, and the larvæ begin their destructive work in the upper leafy portion of the plant, later descending to the base of the stalk, where they attain full growth. This period, from egg to full-grown larva, requires from 20 to 30 days, depending largely on the weather conditions and the vigor of the plant. The larvæ when full-grown pupate in the stalk, usually in the second or third joint from the ground, and in from 7 to 10 days the adult moths of the first generation emerge.

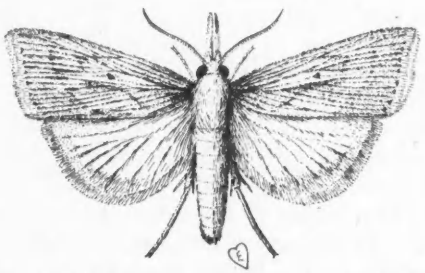

FIG. 8.—Moth or parent of the larger corn stalk-borer. Twice natural size.

The eggs for the second generation are laid in similar positions on the lower leaves or on the stem, and the larvæ, after feeding for a short time on the leaves, go directly to work in the stalk, completing their larval growth in the pith of the lower stalk as did the larvæ of the first generation. No damage is

done to the upper part of the plant by these larvæ of the second generation. By the time they are fullgrown, the corn is rapidly nearing maturity and, instead of pupating in the stalk, they work downward, penetrate to the extreme lower tip of the taproot below ground, and there form a small cavity in which to pass the winter. At this time the larvæ lose the darker markings of the earlier forms and, as overwintering larvæ, are creamy yellow in color. They are plump and active in the fall, but flabby and sluggish after fasting throughout the winter. The only way in which the insect passes the winter is in the form of this overwintering larva, found below the ground in the extreme lower tip of the corn roots. There is no evidence that there are ever more than two generations a year.

As many as a dozen larvæ are sometimes found in one stalk, but seldom do more than two or three of these reach the pupa stage. In the winter there is usually only a single larva in a root, although occasionally two are found, always in separate cavities.

OTHER PLANTS ON WHICH IT FEEDS.

Besides corn this borer has been reported as feeding on sorghum, Johnson grass, guinea corn, grama grass, and rarely on sugar cane. The injury to plants other than corn is never severe but, in planning methods of control, these plants must be considered and an examination made to determine whether or not they are harboring the pest.

NATURAL CHECKS TO ITS INCREASE.

The larger corn stalk-borer has very few natural enemies. A minute wasplike parasite [1] has been found in a few instances living in and destroying the eggs. In one case 10 of these parasites were reared from 2 eggs. The brown, velvety larva of a beetle [2] has been found entering the burrows after the corn has been cut and devouring the larvæ. Termites [3] or white ants, locally known as wood lice, have been observed destroying the larvæ in the stubble in winter, although apparently only when the presence of the larvæ interfered with their work. In a few cases bodies of the borers have been found in the stubble killed by a fungus, as yet undetermined, which envelops their bodies in a white mold. Fungi, however, are too dependent on weather conditions to be of any practical value in controlling the pest.

[1] *Trichogramma pretiosa* Riley.
[2] *Chauliognathus pennsylvanicus* De Geer.
[3] *Leucotermes* spp.

HOW TO PREVENT DAMAGE.

Rotation is one of the best general preventives of injury from insects affecting field crops. Experience has shown that where corn has followed itself upon the same field for two or more years, the loss from the borer has been much greater than where an annual change has been practiced. This is especially noticeable where stalks or stubble from the previous year have been allowed to remain undisturbed throughout the winter. Upon emerging in the spring, the moths, finding themselves surrounded by young corn, commence egg laying at once, and escape the dangers encountered in searching for another field of corn. A forced journey in search of young corn results in the destruction of many of the female moths by birds and other animal enemies and by weather conditions or in failure to find suitable food plants for the young larvæ. A few moths will always succeed in their quest, but the successful proportion will be greatly decreased by persistent crop rotation.

Another remedy, probably the best for this insect, is the thorough destruction, some time before the emergence of the moths in the spring, of all the stalks and stubble remaining in the field from the previous crop. If all this trash can be disposed of at the proper time the moths left to attack the succeeding crop must be reduced greatly, if not altogether exterminated, for the caterpillar is the only form of the insect that passes the winter and the only known location is the tip of the corn taproot. Since it is possible, however, that a few may be able to survive the rigors of winter in the roots of the larger grasses mentioned above, care should be taken to treat these in the same way.

The method employed to dispose of the stalks and stubble will depend largely on conditions in individual cases. If the stubble is cut low and the land is moderately heavy, a thorough deep plowing may suffice, for an inch or two of well settled soil is sufficient to prevent the escape of the moths. Bringing the stubble to the surface where it can dry and be exposed to all the variations of temperature during the winter will kill many of the contained larvæ, but this method depends too much on the state of the weather to be entirely effective. By far the most effective plan is to remove the stubble from the field with a rake and burn it.

ANY method which will insure the complete destruction of the overwintering larvæ, especially if undertaken simultaneously by all the farmers of a locality, will decrease and practically eliminate injury from this insect.

PUBLICATIONS OF UNITED STATES DEPARTMENT OF AGRICULTURE RELATING TO INSECTS INJURIOUS TO CORN.

AVAILABLE FOR FREE DISTRIBUTION BY THE DEPARTMENT.

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Larger Corn Stalk-borer. (Farmers' Bulletin 1025.)
Western Corn Rootworm. (Department Bulletin 8.)
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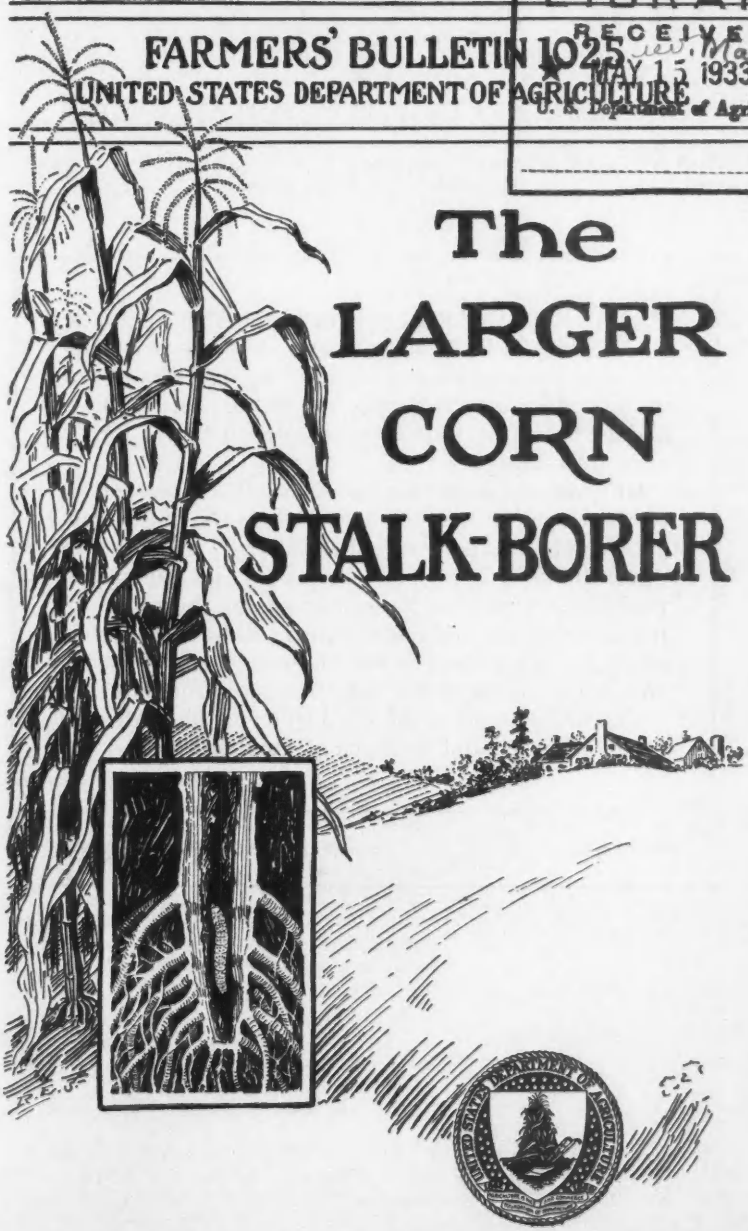
UNITED STATES DEPARTMENT OF AGRICULTURE

The LARGER CORN STALK-BORER



MANY A FINE field of corn in the South Atlantic States is broken down by heavy winds during the later growing season because the stalks had been weakened by insects boring into them. The damage is done by a pale, dark-spotted caterpillar, the larger corn stalk-borer.

Only corn is injured seriously by this insect; some of the larger grasses are its food plants, and sugar-cane sometimes is damaged slightly. There are two generations in a season. As the second generation passes the winter in the corn roots, if the roots are destroyed or plowed out, the pest will be largely subdued. The injury is worst where corn follows corn, so rotation of crops will help to destroy the borer.

This bulletin gives the life history of the borer, its feeding habits, and methods of combating it.

Washington, D. C. Issued April, 1925; revised March, 1933

THE LARGER CORN STALK-BORER[1]

By GEORGE G. AINSLIE,[2] *Associate Entomologist, Division of Cereal and Forage Insects, Bureau of Entomology*

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IN MANY southern cornfields a heavy wind late in the season, before the corn is matured, does great damage by breaking the plants off at the surface of the ground. Usually these broken stems have been weakened by the burrows of a larva or caterpillar (fig. 1) known as the larger corn stalk-borer. Its work is largely within the stem of the plant and is so concealed that, in most cases, unless the stalk breaks, the presence of the insect is unnoticed.

This insect is very similar to the sugarcane borer (*Diatraea saccharalis* Fab.) occurring in the southern parts of Louisiana, Florida, and Texas and in the tropics, and for a long time was supposed to be the same. It has proved to be distinct, and probably is a native of the Atlantic States, from Alabama and northern Florida to Maryland, where it is now found. (Fig. 2.) Even in the southern part of this region, where cane is grown, the insect rarely attacks it, although the sugarcane borer feeds on corn and sugarcane indiscriminately. The corn stalk-borer has also been reported as feeding on sorghum, Johnson grass, guinea corn, and grama grass. The injury to plants other than corn is never severe, but when methods of control are being planned these plants should be examined to determine whether they are harboring the pest.

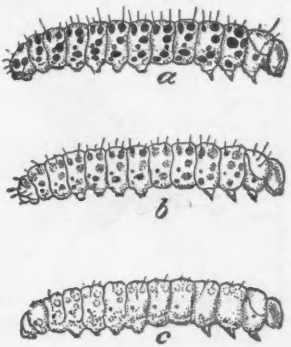

FIGURE 1.—The larger corn stalk-borer; *a*, Summer form of larva; *b*, *c*, hibernating forms of larvae. Enlarged. (Redrawn from Howard)

EXTENT AND NATURE OF DAMAGE

The insect most frequently injures corn in Georgia, South Carolina, North Carolina, and Virginia, but occasionally causes cornfields in the southern and eastern part of Maryland to be abandoned. Al-

[1] *Diatraea crambidoides* Grote; order Lepidoptera, family Pyralidae, subfamily Crambinae.
[2] Died Dec. 19, 1930. This revision was made by W. J. Phillips.

though it causes serious losses every year throughout many Southern States, farmers generally are so accustomed to it that they pay little attention unless fields are almost totally destroyed.

The first brood of larvae, if abundant, may almost entirely destroy whole fields, killing many plants outright, and stunting others so badly that they produce no grain. The larvae of the second generation frequently do as much damage as those of the first generation. particularly in corn on poor soil. The larval tunnels in late corn so weaken the stalks that any ordinary rain or windstorm causes the plants to break over before they are mature and therefore produce little or no grain.

The damage done by the first generation is almost exclusively in the "throat" of the plant until the worms are about half grown, feeding principally in the unfolding leaves and causing the characteristic "ragworm" or "budworm" injury. If they injure the tender growing tip within the protecting leaves they destroy all chance that the plant will become normally productive. This feeding makes the characteristic irregular holes, arranged somewhat definitely in rows (fig. 3) across the blades. While several other insects similarly mutilate the leaf, this insect is responsible for much of the so-called budworm damage in many localities. The larvae may feed on the unfolded blades, making holes irregular in shape and arrangement. Small larvae, especially if there are several in one plant, may tunnel the midribs of the leaves.

FIGURE 2.—Map with shaded area showing present known distribution of the larger corn stalk-borer

After the larvae are about half grown they crawl down the stalk and burrow into the lower joints, usually entering between the second and sixth joints above the ground. They tunnel up and down inside the stalk (fig. 4), doing injury that is seldom evident unless the infested stalks are broken by the wind. Entrance and emergence holes (fig. 5) are other evidences of this type of injury.

DESCRIPTIONS OF THE DIFFERENT FORMS OR STAGES

The four successive stages in the development of this insect are (1) the egg, (2) the larva, caterpillar, or borer, (3) the pupa, chrysalis, or resting stage, and (4) the adult, or moth.

THE EGG

The eggs are flat and scalelike, almost circular in outline, and placed in rows or irregularly, overlapping one another shingle fashion. From 2 to 25 are laid in one place on the underside of a

lower leaf, or occasionally on the upper side or on the stem. Creamy white when first laid, they change gradually to reddish brown.

THE LARVA

The larva of the first generation (fig. 1, *a*), when full grown, is a robust, dirty-white caterpillar 1 inch long, thickly covered with round or irregular dark spots, each bearing a short, dark bristle. When the larva is small, these markings almost touch one another, giving the whole insect a dark, hairy appearance. The head and neck

FIGURE 3.—Work of the larger corn stalk-borer, showing damage to the leaves by larvae of the first generation

shield of all stages are brownish yellow. The overwintering larva of the second generation (fig. 1, *b*, *c*) gradually loses the darker markings and after the last molt remains unspotted and light yellow, except for the head and neck shield, which retain the brownish-yellow color.

THE PUPA

When first formed, the pupa (fig. 6) is light honey yellow in color, soon changing to rich mahogany brown. It is about seven-eighths inch long.

THE ADULT, OR MOTH

The female moth (fig. 7) ranges in color from almost white to smoky yellow. The fore wings, which spread to about 1¼ inches, are darker than the hind wings, and bear faint markings. When at rest the wings are held close to the body, forming an acute triangle. Egg-laying occurs, for the most part, either at night or in the dusk of evening.

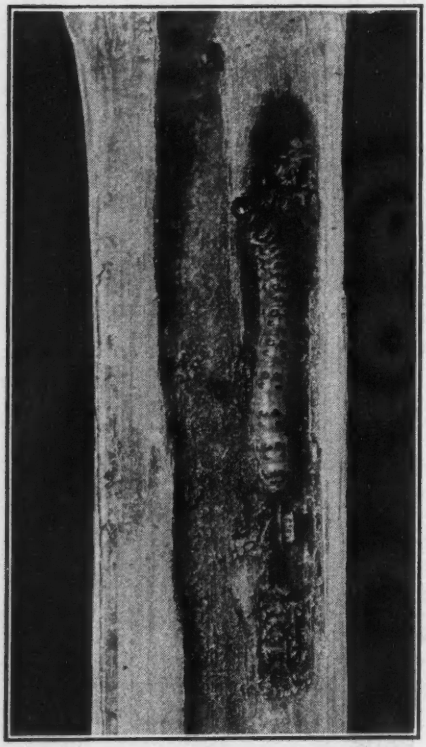

FIGURE 4.—Work of the larva of the larger corn stalk-borer in a cornstalk. Enlarged

HABITS OF THE LARVAE, OR BORERS

Immediately upon leaving the egg in the spring, each young larva of the first generation, spinning a silken thread behind it, goes down into the throat of the plant as far as the moisture usually standing there will allow, and begins to feed, riddling the yet-unfolded clusters.

The larva soon leaves the more leafy portion of the plant and enters the stalk lower down, burrowing through the pith. When fully grown it cuts a circular hole in the outer wall of the stalk, spins a few loose threads across the opening, retreats a short distance, plugs the burrow below with digested pith, and in the chamber thus formed slowly changes to the resting stage, or pupa. (Fig. 6.)

The larvae of the second generation work in a similar manner, except that when they appear the tassel has been formed and damage is confined to the lower stalk.

LIFE OF THE INSECT THROUGHOUT THE YEAR

During the early winter the insect is a robust, creamy-white larva in the lower part of the stalk, or, if the corn has been cut, in the stubble. Later in the season the larva penetrates to the root and spends the winter in a small cavity below the surface of the ground, well protected from birds, predatory insects, and unfavorable weather. From the time the corn is mature until about corn-planting time this caterpillar remains inactive. About the time the ground is being prepared for corn, from March 15 to April 30, depending

on the locality, this larva changes into a reddish-brown pupa, or chrysalis. After 10 or more days in this stage the pale yellowish-brown moth emerges from the pupal case. The moths mate and the females begin to deposit eggs on the underside of the leaves. The larvae hatching from these eggs form the first brood of the season.

The eggs hatch in from 7 to 10 days, and the larvae begin their destructive work. The period from egg to full-grown larva is from 20 to 30 days, depending on weather and the vigor of the plant. The full grown larvae pupate in the stalk, usually in the second or third joint from the ground, and in from 7 to 10 days the moths of the first generation emerge.

FIGURE 5.—Work of the larvae of the second generation of the larger corn stalk-borer in old stalks. About natural size

The eggs for the second generation are laid as are those for the first generation, but on the lower leaves or the stem of the corn, and the larvae, after feeding for a short time on the leaves, go directly to work in the stalk, completing their larval growth in the pith of the lower stalk as did the larvae of the first generation.

The larger corn stalk-borer passes the winter only in the form of the overwintering larva in the cavity in the extreme lower tip of the corn root. There is no evidence of more than two generations a year.

As many as 15 larvae are sometimes found in one stalk, but seldom do more than 2 or 3 of these reach the pupal stage. In the winter there is usually only a single larva in a root, although occasionally two are found, always in separate cavities.

HOW TO PREVENT DAMAGE

Rotation is one of the best general preventives of injury from insects affecting field crops. Where corn has followed corn upon

the same field for two or more years, the loss from the borer has been much greater than where an annual change has been made, especially if stalks or stubble from the previous crop have remained undisturbed throughout the winter.

The most effective defense against the larger corn stalk-borer is thoroughly to destroy all old corn stubble left in the field from the previous crop before the moths emerge in the spring. Disposing of such refuse at the proper time will practically eradicate the insect. A few borers may survive in the roots of the larger grasses, so these roots should also be destroyed.

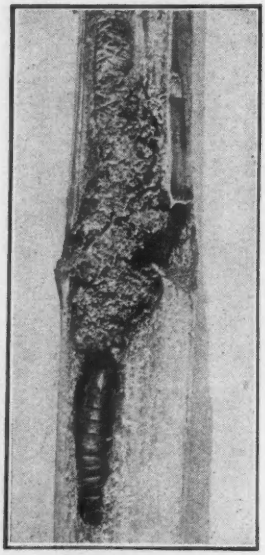

FIGURE 6.—Pupa of first generation of the larger corn stalk-borer in injured stalk of corn. About natural size

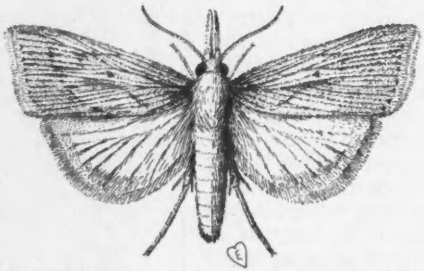

FIGURE 7.—Moth or adult of the larger corn stalk-borer. Twice natural size

A simple and effective remedy in the more northern range of this insect is to plow the stubs out with a turning plow and then harrow the land once in order to remove the soil from the stubs and expose the larvae to the weather. Plowing too deep covers the stubs with too much soil, and they can not be sufficiently uncovered by one harrowing. On the other hand, too shallow plowing which cuts off the stubs at or near the surface of the ground will not expose the larvae sufficiently. This operation should be completed not later than December 10, and the stubs should be allowed to remain exposed until about March 1.

If corn is cut low and the land plowed deeply, so that the stubs are covered with about 2 inches of soil, the moths will be unable to emerge, and control should be very satisfactory.

Any method that insures complete destruction of the overwintering larvae, especially if undertaken simultaneously by all the farmers of a locality, will reduce the numbers of the insect and practically eliminate injury from it.

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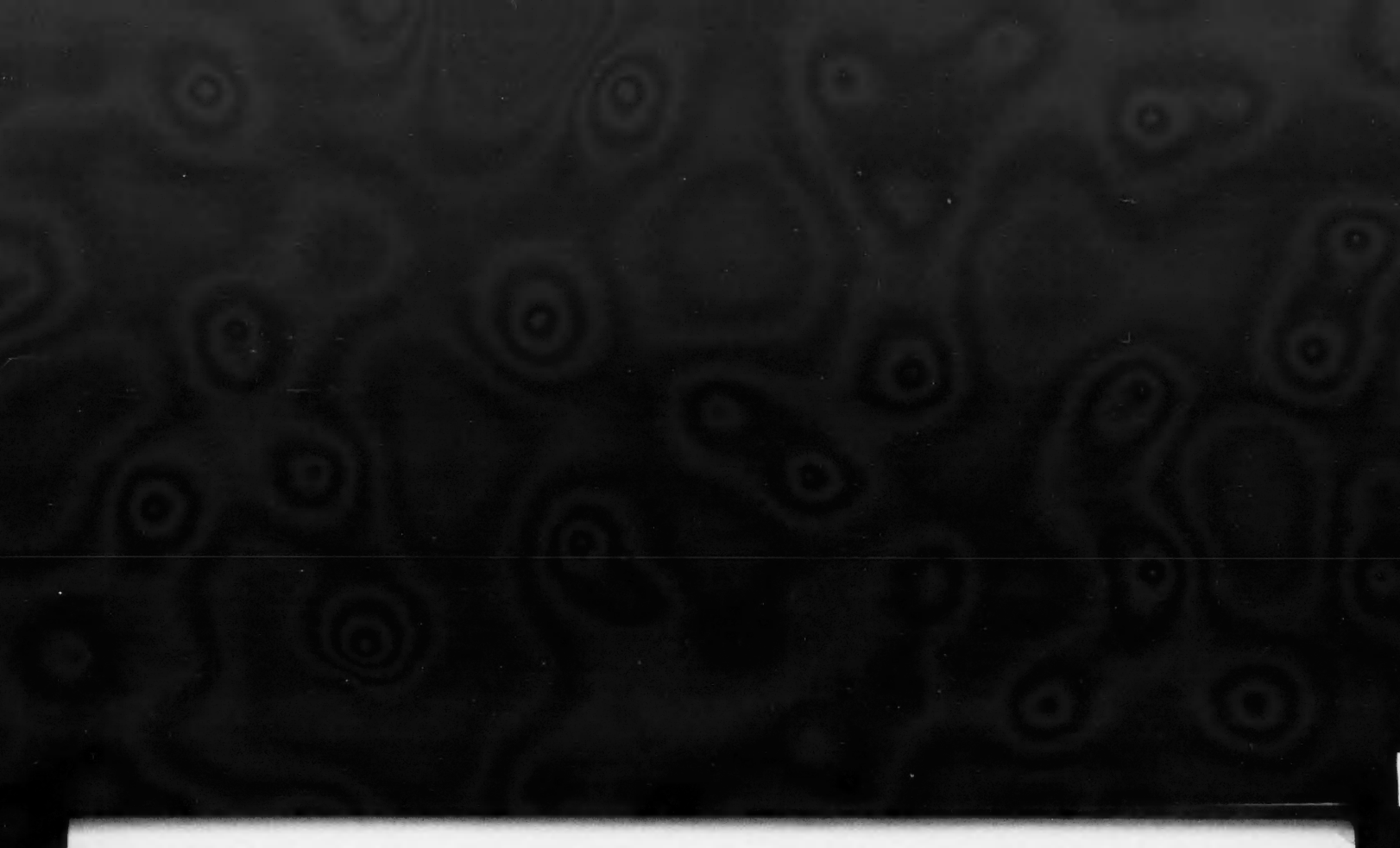
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